METHOD AND APPARATUS FOR PRODUCING METHANE GAS

Applicant claims priority rights in European Patent Application 01102374.4 filed 02/02/01.

FIELD OF THE INVENTION

This invention relates to an apparatus for producing methane gas particularly on cattle ranches and dairy farms wherein the apparatus is portable and can be expanded and contracted or totally collapsed to accommodate the need of the user.

BACKGROUND OF THE INVENTION

It has been known for years that manure generated by cattle emits methane gas and can be enclosed so that the gas can be captured. In a preferred process, the manure is mixed with certain vegetation, e.g., straw, and then treated with inoculants to generate a reaction that accelerates the production of methane gas. The material to be treated is referred to as biomass material. The methane gas can be drawn off and used as a source of power, e.g., by burning. In spite of this knowledge, it has not been considered feasible to set up a methane production plant on a farm site nor has it been considered feasible to haul the manure to an off site methane producing plant.

BRIEF DESCRIPTION OF THE INVENTION

The present invention enables low cost production of methane gas by replacing heretofore fixed structures with a large plastic bag, an example of which is used in composting. See U.S. Patent No. 5,461,843.

The flexible bag brings a number of advantages to the methane producing process. The bags are available in sizes, e.g., 5 and 10 feet in diameter and 100 or more feet in length. The bag can be deployed from a bag filling machine as desired to accommodate the amount of biomass material to be processed. Multiple bags can be connected to accommodate any volume of the material. The bags can be used to compost the material upon depletion of methane production. Following the composting stage, the material can be used as fertilizer and the bags can be readily collapsed to a small fraction of its filled capacity for disposal or recycling.

These and other advantages will become more apparent upon reference to the following detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective illustration of a machine such as used for filling a bag with compost including tubing for aeration

purposes, the machine being here used for filling the bag with biomass material for methane production in accordance with the present invention;

Fig. 1A is a top plan view of the machine of Fig. 1;

Fig. 2 illustrates a bag that has been filled with the biomass material for methane production, the bag end being extended and tied off for receiving the methane gas;

Fig. 3 illustrates the bag of Fig. 2 but following expansion of the bag end resulting from methane gas production;

Fig. 4 is a cross sectional view as taken on lines 4-4 of Fig. 3;

Figs. 5 and 5A illustrate a modification of the filled bag of Fig. 3 provided with components for heating the material in the bag; and

Fig. 6 is a schematic over view of the system for producing and utilizing methane gas produced from multiple bags.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference is first made to Fig. 1 which illustrates a bag filling machine 10 used for filling a bag 12 with material to be processed for producing methane gas in accordance with the present invention. The bag 12 having a diameter, e.g., of 5 feet, is placed over the collapsed tunnel 14 and the tunnel is expanded to the size of the bag diameter (dash line 14), e.g., 5 feet in diameter. However such machines are also designed to accommodate bags that are various sizes up to 10 feet in diameter. The machine illustrated is similar in most respects to a bagging machine used for bagging and processing compost disclosed in U.S. Patent No. 5,724,793 which patent and the present invention are commonly owned.

As will be noted, preceding the tunnel 14 is a hopper 16 into which a biomass material (arrow 17) is deposited. A piston 18 sized to fit the opening in the tunnel indicated at dash line 14 is reciprocated through the hopper to shove the material 17 from the hopper into and through the tunnel 14 and thus into the bag 12.

The biomass material is preferably a material that does not readily flow and can be somewhat compacted into the bag as will be discussed. A mixture having a solids content of about 30% is desired but can be varied (generally upward) to accommodate a user's need.

The machine also includes one or more fixed guide tubes 20, e.g., a machine adapted to fill a five foot diameter bag may have one guide tube and for filling a ten foot diameter bag have two guide tubes. The guide tubes 20 extend through sized openings in the piston 18 and through the hopper 16 and into the tunnel 14 as seen in Fig. 1A. Lengths of perforated conduit are fed through the guide tubes 20 and are deposited into the bag as the bag is filled. As the bag 12 is filled, the machine moves away from the filled portion of the bag and the conduit 22 is held in place by the material to continuously draw the conduit off the stored coil 24 of conduit housed in bins 26 carried by the machine.

When the bag 12 is filled to the desired capacity, a length of bag 28 is removed from the tunnel, e.g., about 10 feet of bag, the end is then tied shut as indicated in Fig. 2. The end 28 of the bag as shown remains collapsed only until the reaction of the inoculant with the biomass begins producing the methane gas where upon the methane gas indicated by arrows 32 expands the bag to fill end 28 as shown in Fig. 3.

A tube or pipe 30 is inserted into the bag end 28 and the methane gas is released from the bag end 28 through the tube 30 as illustrated in Fig. 3. As will be understood, the gas will rise to the top and then seek the open cavity of the bag. This can be

enhanced by the placement of a perforated conduit 34 along the top of the bag as seen in Figs. 3 and 4. This conduit is inserted in the same manner as conduit 22. However, conduit 34 is not exposed to the atmosphere as oxygen is detrimental to the methane producing process. Conversely, conduit 22 is exposed to the atmosphere as infusion of oxygen is desirable for the composting step of the disclosed process.

The process as described continues until the biomass material is depleted of its ability to produce methane gas. The depleted biomass material in the bag can be discarded or preferably the material is composted in the manner described for the '793 patent. The conduit for providing such treatment is indicated in Fig. 4 as perforated conduit 22. Thus, the biomass material is reduced to compost and used as fertilizer and the bag can then be collapsed to a small fraction of its filled state and recycled.

Figs. 5 and 5A illustrate a variation from the above-described apparatus and process only in that in Figs. 5 and 5A it is assumed that the climate is cold and that it may be desired to provide additional heat to insure the desired reaction rate of the biomass material. Such additional heat is provided in a couple of ways. The bag 12' is laid down on pad 36 which is provided with water passages 38 which passages are connected to in and out water lines

40. Hot water can thus be circulated through the pad to warm the biomass material from the bottom up. Further, a plastic sheet or robe 42 can be placed over bag 12' and water lines 44 can be placed between the robe 42 and bag 12' with hot water again circulated through the lines 44 to maintain a desired temperature of the biomass and material in the bag. The engine of the bagging machine may be used to heat the water circulated through the pipes 44.

Reference is now made to Fig. 6 which schematically illustrates a system using the above-described bag filling process. It will be appreciated that the system can include a single bag or a plurality of bags 12. In Fig. 6, a plurality of bags 12 containing the methane gas producing biomass material 17 are linked together via a methane gas line 46. Thus, the tubes 30 are each connected to line 46 which conveys the methane gas to a collection site 48. Equipment for using the methane gas, e.g., at the site 48, may include a furnace, an engine, a chiller, fuel cells or other equipment that can beneficially burn methane gas. Alternatively, the gas can be selectively conveyed to a multiple of other sites as indicated by arrows. If heat is produced at site 48, hot water circulating lines 40 can be connected between the site 48 and the hot water lines 44 and pad passages 38.

The process and apparatus as described above is greatly

simplified over prior methane producing plants. The structure is readily made portable prior to and after completion of the gas production and the system can be expanded or reduced as desired to meet the need of the user. Whereas a preferred embodiment is described, numerous modifications will become apparent to those skilled in the art. The invention as defined in the accompanying claims is intended to encompass such modifications. Accordingly, the claim terms are to be interpreted in accordance with their normal and usual meaning.